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DESCRIPTION *of a* PORTABLE BAROMETER

By the Reverend GILBERT AUSTIN, *A. M. and M. R. I. A.*

THE barometer, in the hands of modern philoſophers, by the remarkable facility and ſucceſs with which it has been applied to the meaſurement of heights, ſeems to have acquired a new property, and to have obtained a higher degree of eſtimation among the learned. It has therefore been thought worthy of every cultivation that might render it more perfect or convenient, and every attempt to improve it has been favourably received. Read Dec. 4, 1790.

THE inſtrument, in its moſt ſimple form, is moſt accurate, but not portable. To retain its ſimplicity, therefore, and render it portable and eaſy in the application, appears the proper object of improvement.

IN the beſt modern inſtruments of this kind a conſiderable degree of accuracy has been attained, but their conſtruction is

not

not ſufficiently ſimple. They are, therefore, difficult to execute, hard to keep in repair, and conſequently too expenſive to ſerve the advancement of knowledge as extenſively as might be wiſhed. I might alſo add that the difficulty of adjuſting them correctly renders the obſervations more uncertain than they might be were the inſtrument leſs complex.

As a ſmall attempt towards the improvement of this inſtrument, I beg leave to offer to the Academy the following deſcription of a portable barometer of more ſimple conſtruction.

THE beſt barometers of the modern conſtruction are furniſhed with floating gages, in order to aſcertain the proper height of the mercury in the baſon, from the ſurface of which the ſcale commences. In the barometer now offered to the Academy this end is more ſimply accompliſhed by making a hole in the ſide of the baſon at a proper height, ſo that it cannot at any time, when hanging perpendicular, contain more mercury than will exactly riſe to the ſtandard level. This will be beſt underſtood by the general deſcription, Fig. 1.

THE body of the barometer conſiſts of an upper box *a*, and a lower *b*. In the upper box is the baſon of mercury *f*, in which the tube *r* with its attached thermometer are immerſed. The baſon communicates with a bag *e* (which hangs in the lower box, and is glued cloſely to the upper) by a long perforation *g* in the ſide and parallel to it, which is opened and ſhut at pleaſure by a ſtop cock *h*, with a hole *k* in the direction of its axis reaching as far as the perforation in the ſide of the box, and

and then turning off at right angles to communicate with the perforation. Through this paſſage the mercury overflows until it has deſcended to its ſtandard level, and through this it is forced back again from the bag into the baſon when it is neceſſary to fill it. For conveniently effecting this, the lower box is open at the bottom *m* wide enough to admit the thumb, and has in it a looſe piece *n* with a cavity anſwering the convexity of the bottom of the upper box, which is preſſed by the thumb againſt the bag, and forces (with little difficulty) up into the baſon the mercury, which finds no paſſage but through the perforation. A ſmall air-hole *o* is in the top of the upper box, which is opened or ſhut by a ſmall ivory peg or ſtop-cock.

In order to render the barometer portable, firſt cloſe the air-hole to prevent the mercury from running out through it, then invert the barometer, preſs the bag with the looſe piece ſo as to fill completely the cavity of the baſon (if any air is ſuppoſed to remain in the bottom of the baſon). now the top, unſcrew a ſmall ſteel pin *x* which paſſes from the outſide of the upper box into the bottom of the baſon, and force the mercury out of the bag until it appears in this hole, the air is then perfectly excluded and the cavity full of mercury, ſhut the ſtop-cock by turning it by the ſquare *q* with its key one-quarter or one-half round, and ſcrew again into its place the ſteel ſcrew. It will now be found very portable, particularly if carried in an inverted poſition.

To

To make it ready for obſervation, it is to be ſuſpended either on its ſtand or on a hook, and holding it inclined, the ſtop-cock is firſt to be opened, afterwards the air-hole, and then it is to be let down very gently to its perpendicular direction. The ſcale will ſhew truly the ſtate of the barometer.

If any accident or ſhake ſhould cauſe more mercury to flow out of the baſon than enough to fill it to the ſtandard height, the adjuſtment may be repeated as often as thought neceſſary by only inclining the barometer, and forcing mercury from the bag into the baſon. It will be proper to obſerve the height of the mercury by the ſcale at each trial, and when it ſtands at the higheſt the barometer is properly adjuſted. If it can be hung truly perpendicular, either by bracing it to its own ſtand, or by fixing it to a firm poſt, there is no occaſion to diſturb it for a new adjuſtment; the mercury may be forced into it as it hangs, and be ſuffered to find its proper level by overflowing. This may be found convenient for obſervations in the houſe; if it ſhould be preferred to uſe it as a barometer of the common conſtruction, it is only neceſſary to adjuſt it once, and ſhut the ſtop-cock.

The two boxes of this barometer may be made of box-wood or ivory of any convenient ſize that may anſwer beſt to render them portable. The diameter of the baſon may be very much reduced, as the accuracy of this inſtrument does not depend on its ſize. It need not be much larger than may be conveniently held in the hand, as the head of a walking-cane. If the tube is neatly mounted in a drawn braſs tube it may be encloſed within the

the legs of a triangle, ſo as not altogether to be a much greater incumbrance than a common walking-cane.

As the ſtop-cock cannot otherwiſe be conveniently ſecured from falling out, a collar of braſs is turned to fit a ſhoulder left on it for that purpoſe, and ſcrewed over it, as in the Fig. 3.

The greateſt inconvenience which occurs to me in the uſe of this barometer is the chance of ſhaking out too much mercury in adjuſting it, or the danger of its being diſturbed by the wind. But a little practice will prevent any uncertainty from theſe cauſes, and that without much trouble; beſides the barometer may be faſtened in a perpendicular direction.

A greater objection ſeems to ariſe from the danger of forcing air into the mercury which is to fill the baſon from the bag below. But from the ſmall quantity neceſſary to make it overflow, little inaccuracy ſeems to be apprehended; and even what is confined with the reſt in the box when the inſtrument is to be carried about will hardly injure to any perceptible degree that in the tube, as leſs agitation can take place in this than any other barometer; for the air in maſſes or ſenſible bubbles is more completely excluded, and the cavity being leſs irregular does not allow any air to lodge in corners as may about the floating gages, and various ſtop-cocks of thoſe on a different conſtruction.

AMONG other advantages of the preſent barometer it ſeems to poſſeſs the following: There is no waſte of mercury, and the ſurface in the baſon is more accurately determined than can be done by floating gages; as errors may ariſe in the adjuſtment of them from parallax, from friction, and from their not diſtinguiſhing accurately very ſmall variations in the altitude of the ſurface, as the preſent barometer does.

THE following experiments ſhew that four grains of mercury cannot be added to the quantity which reaches to the ſtandard height in the baſon without overflowing. And yet four grains of mercury or more diffuſed over a circular ſurface an inch in diameter (about the diameter of the baſon I made the experiment upon) would hardly raiſe it ſenſibly, the bulk is ſo ſmall in proportion to the weight.

I SUSPENDED (ſee Fig. 2) at the arm of a balance, and counterpoiſed the barometer. I took out the ſtop-cock with the hole at right angles which communicates with the perforation in the ſide, and conducts the overflowing mercury into the bag, and put in its place one with a hole of equal diameter in the direction of the axis only, and opening without the box, ſo that the mercury, which was more than enough to fill the baſon to the ſtandard height, ſhould (through this place) flow out of the baſon into a veſſel not at all connected with it. I balanced the barometer accurately when the baſon was filled as high as it could contain mercury, hanging freely and in a perpendicular direction. I then frequently inclined the barometer, and through the

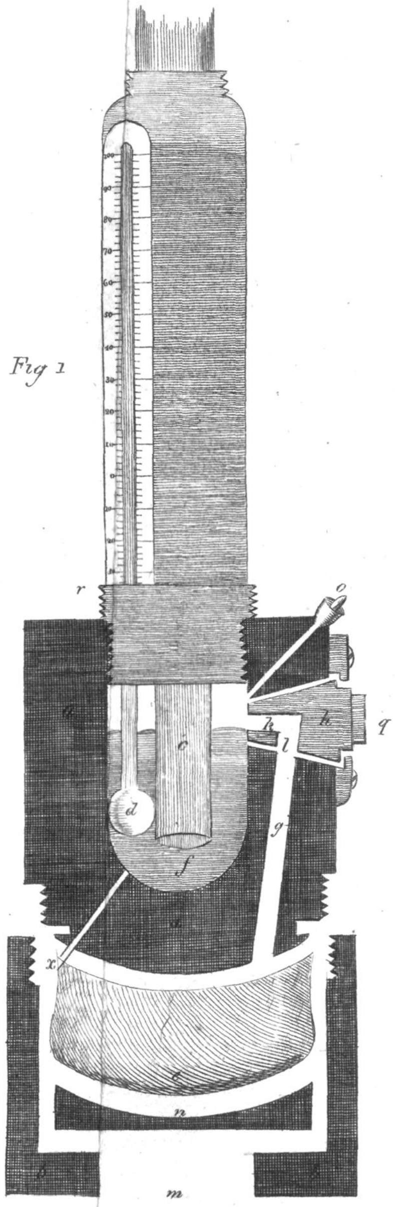


Fig 1

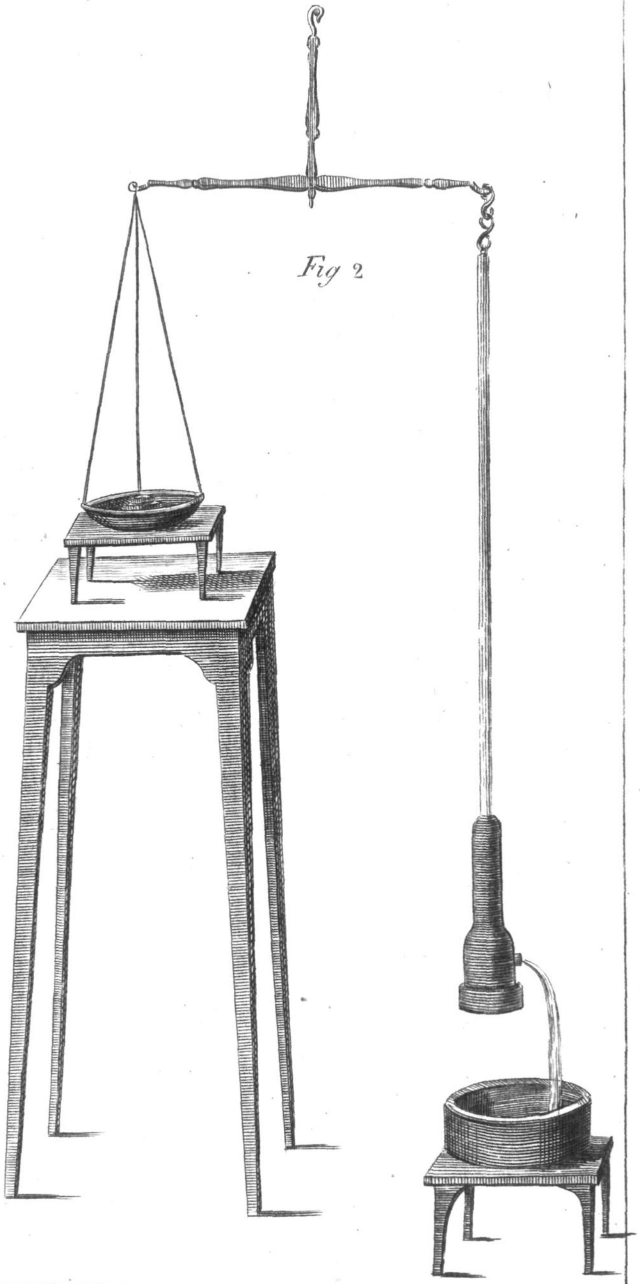


Fig 2

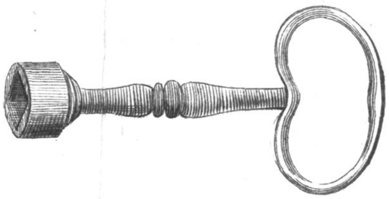
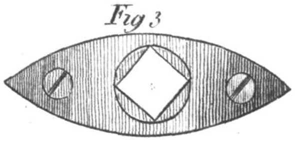


Fig 3



the piece above-mentioned introduced more mercury into the baſon, ſo as to overfil it when hanging perpendicularly; I let it deſcend carefully and gently to its perpendicular direction, and let it depend from the arm of the balance as before. The ſuperfluous mercury run over, and what remained (provided no ſudden concuſſion was given to the ſcale or barometer in deſcending) uniformly weighed as the firſt, and remained in exact equilibrio. The variation from accidents ſometimes, but rarely, amounted to four grains. The balance I uſed ſenſibly inclined with four grains when charged with this weight.